

The Value of the Right Competence



Fabrizio Sara
The MathWorks Italy
Managing Director

**It is expected, that by 2022,
27% of available jobs will be in
roles that don't yet exist.**

- Boston Consulting Group



Agenda

- A look to the future

Megatrends

- MathWorks

How do we respond to Megatrends

- Modeling and Simulation

Model Based Design, capture intellectual property

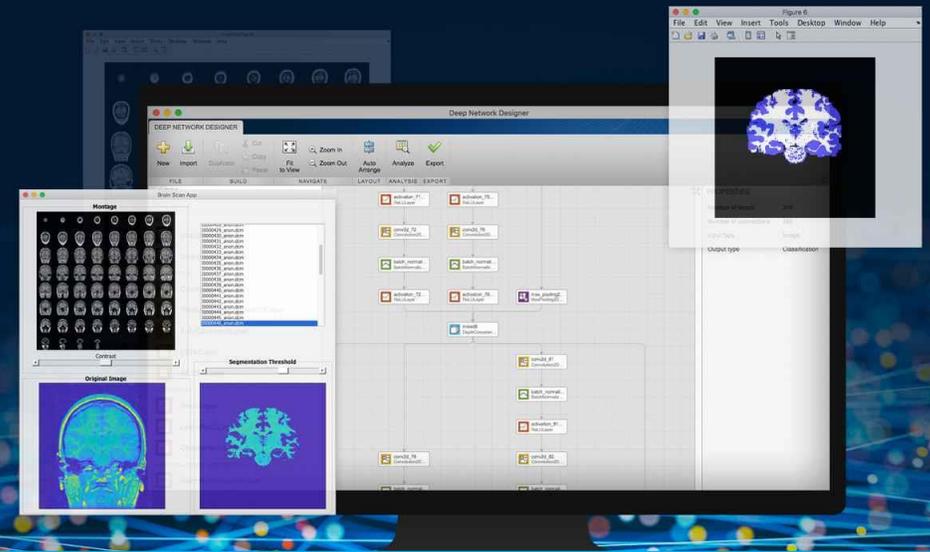
- The engineering Platform for AI

Artificial Intelligence in The MathWorks

- Opportunities

Where to invest to align with the emerging trends

MATLAB® & SIMULINK®



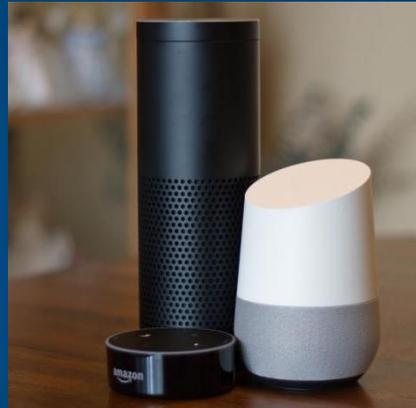
A look to the future



1

Algorithms and Software in Everything

- Smart devices
- New machines
- All university departments, not just computer science



Transistor Production per Person



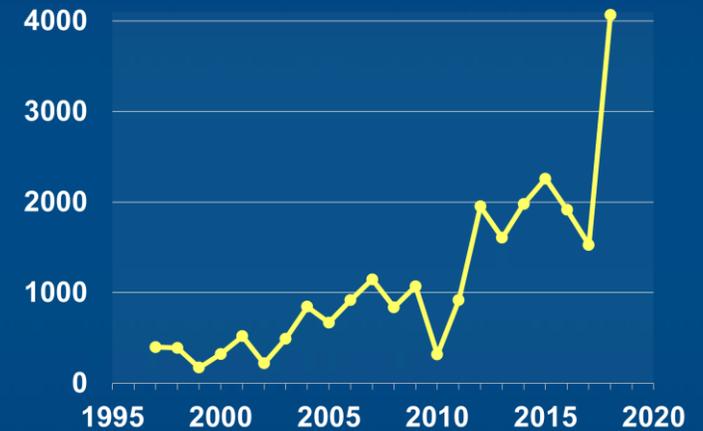
2

Artificial Intelligence (AI)

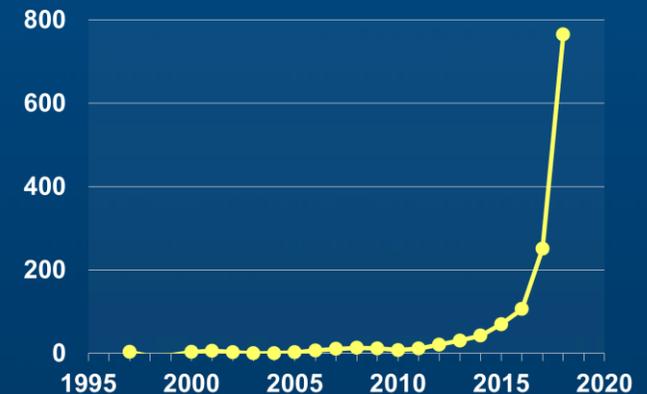
- Machine Learning
- Deep Learning



Machine Learning publications



Deep Learning publications



3

Autonomous Systems



Digital Transformation

Companies

- “Last-mile” connection to their customers
 - “Sensors”, telemetry, usage data
- Software in everything
- Data science
- AI (Machine and Deep Learning)
- Industry 4.0

5 Rise of Cloud Platforms

- Amazon Web Services, Microsoft Azure
- Containerization, orchestration
- Software processes migrating into engineering and science
 - Agile
 - Repos
 - Continuous integration



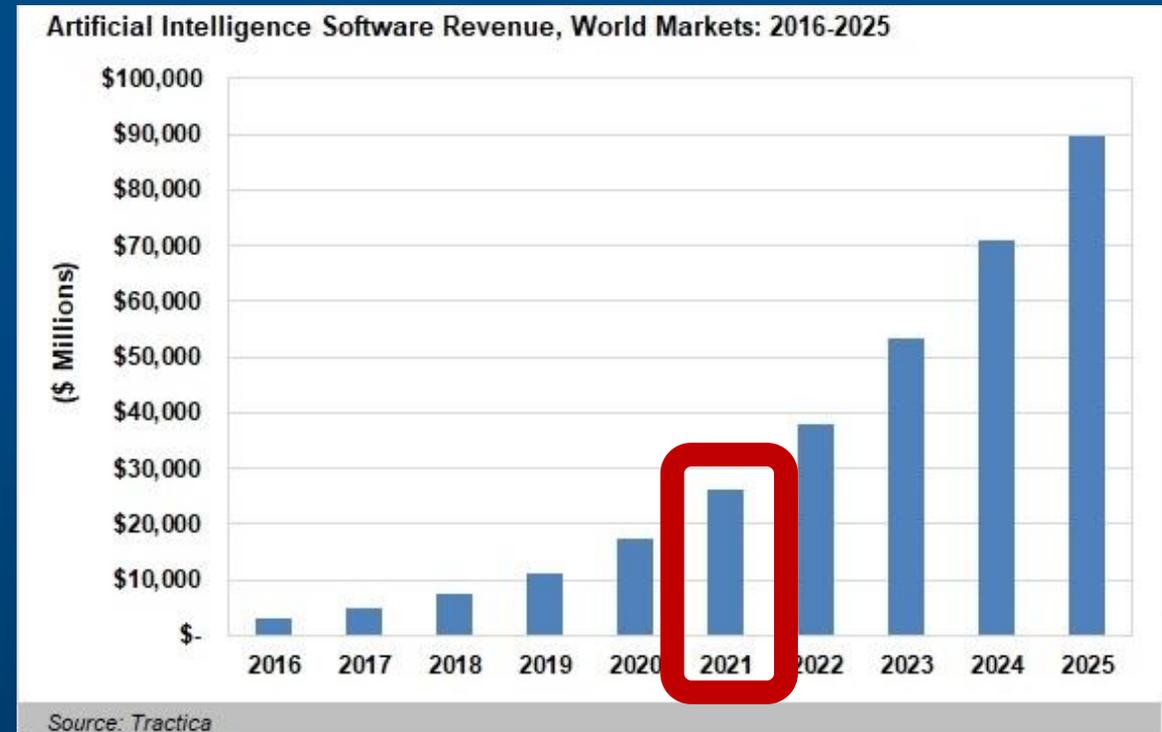
6 Electrification of Everything

- Transportation
- Shift from Internal Combustion Engine only to Electric and Hybrid-Electric Vehicles
- Building heating and cooling
- Small electric motors in everything

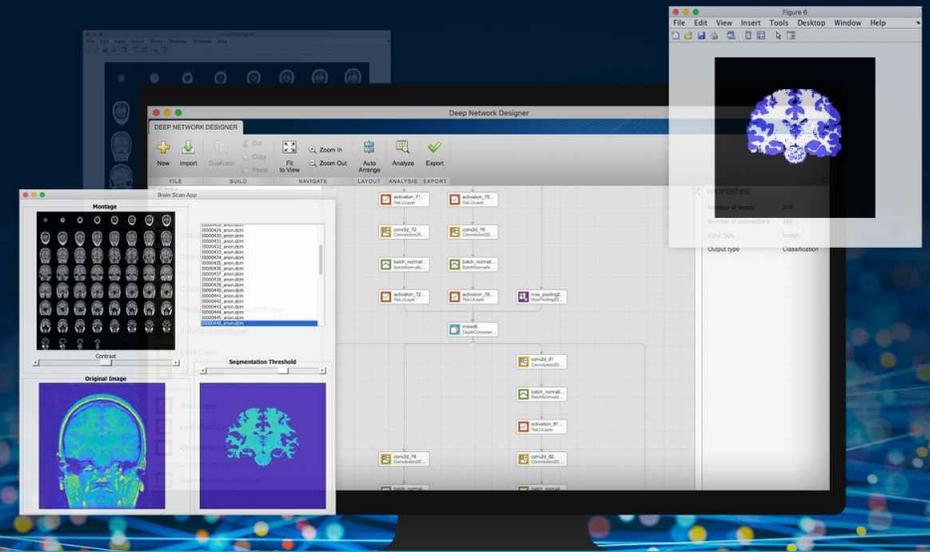


2021 MEGATRENDS

1. Software in Everything
2. Artificial Intelligence
3. Autonomous Systems
4. Digital Transformation
5. Rise of Cloud Platforms
6. Electrification of Everything



MATLAB® & SIMULINK®



The MathWorks



MathWorks Capabilities Adopted Across Industries



Aerospace and Defense



Automotive



Communications
"Use when science, engineering, and



Neuroscience



Biological Sciences



Railway Systems

Domain
ware
S



Energy Production



Non-legacy systems,
increasingly data-
centric and



Medical Devices

development



Biotech and Pharmaceutical



Process Industries



Industrial Machinery



Semiconductors



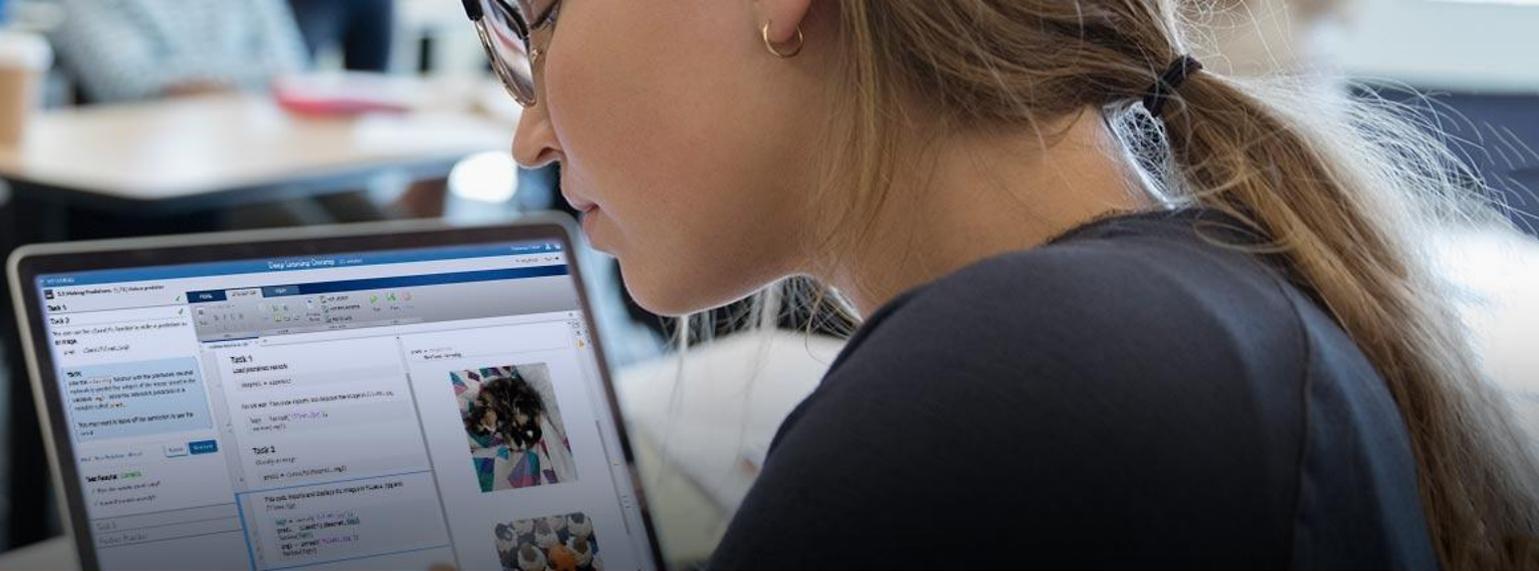
Software and Internet



Financial Services

“Everyone who comes in as a new hire already knows MATLAB, because **they all had it in college**. The learning curve is significantly lessened as a result.”

Jeff Corn, Chief of Engineering Projects Section
U.S. Air Force



- MATLAB and Simulink are the tools of inspiration and innovation used by students, educators, and researchers around the world.



6500+

colleges and universities
teach our software



2100+

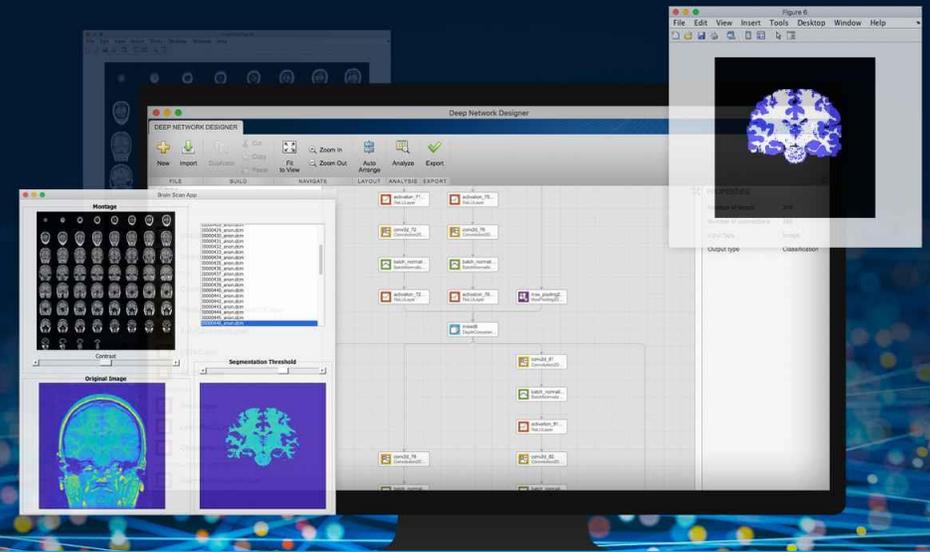
MATLAB and Simulink-
based books



Tens of Thousands

of skilled graduates enter
the workforce each year

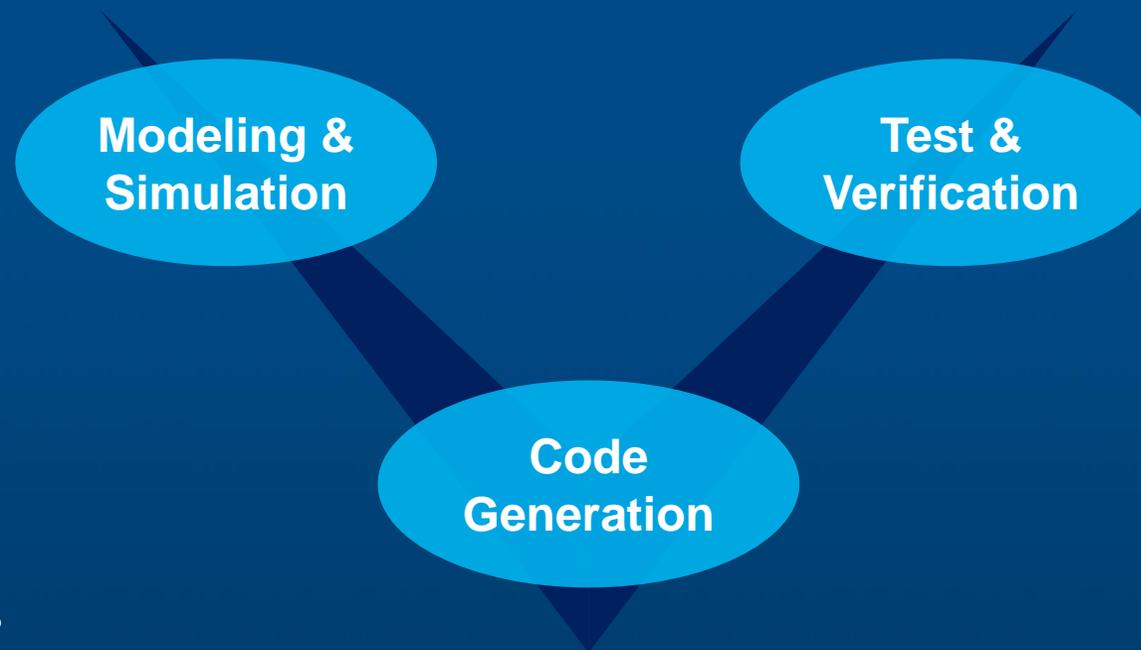
MATLAB® & SIMULINK®



Modeling and Simulation



Model-Based Design



Ease-of-use
Vertical solutions
Scaling up

Vertical solutions

MODELING & SIMULATION

Controls



Signal Processing



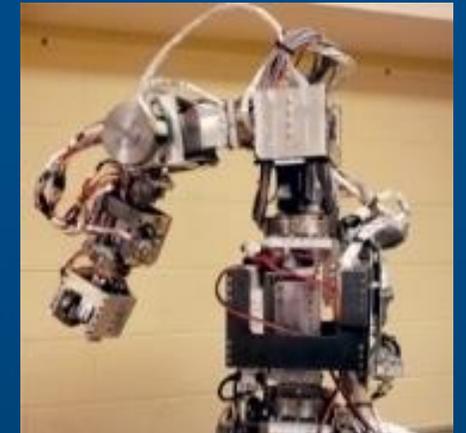
Wireless



Vision



Robotics

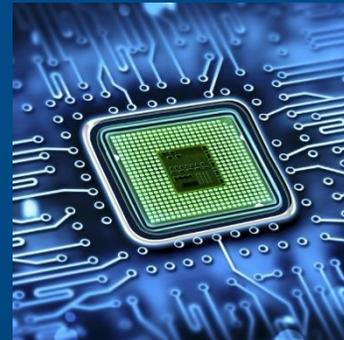


Vertical solutions

MODELING & SIMULATION



Chip Design



Mixed-Signals

Electric Motors



Motor Control

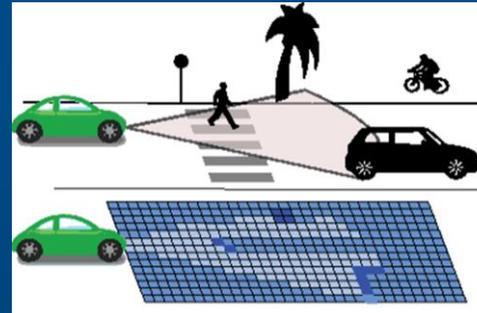
Vertical solutions

MODELING & SIMULATION

Autonomous systems



Navigation & Tracking



Sensor Fusion & Tracking
Navigation

Perception



Deep Learning
Computer Vision
Phased Array
LIDAR

Industry



Automated Driving
Robotics System
UAV

Vertical solutions

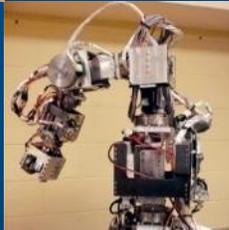
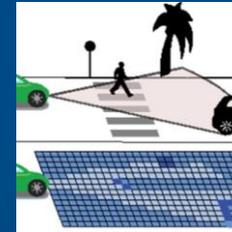
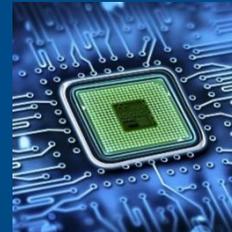
MODELING & SIMULATION

Software Services



Vertical solutions

MODELING & SIMULATION

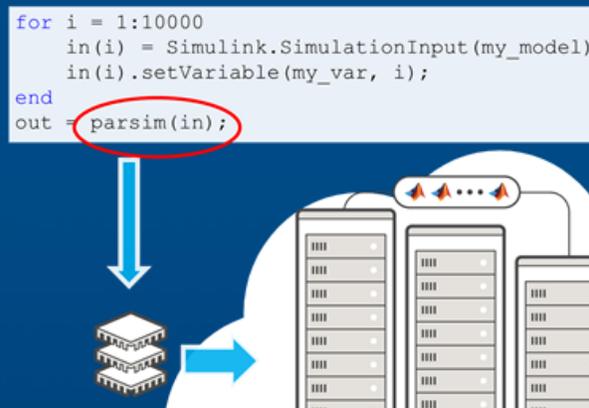


Scaling up

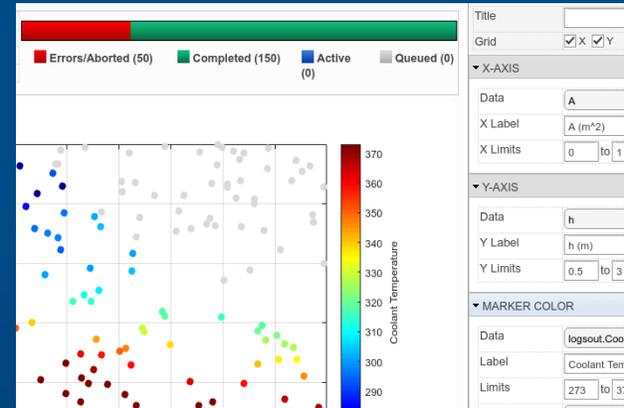
MODELING & SIMULATION



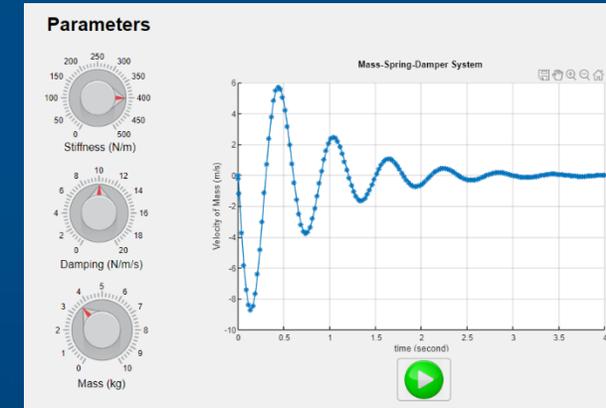
X 1,000,000's



Parallel simulations



Simulation Manager



Simulink Compiler



Modeling & Simulation

Code Generation



Code
Generation

```
#include "AutomatedParkingValetAlgorithm.h"
#include "AutomatedParkingValetAlgorithm_private.h"

int32_T div_s32_floor(int32_T numerator, int32_T denominator)
{
    int32_T quotient;
    uint32_T absNumerator;
    uint32_T absDenominator;
    uint32_T tempAbsQuotient;
    boolean_T quotientNeedsNegation;
    if (denominator == 0) {
        quotient = numerator >= 0 ? MAX_int32_T : MIN_int32_T;
    }
    // Divide by zero handler
    else {
        absNumerator = numerator < 0 ? ~static_cast<uint32_T>(numerator) + 1U :
            static_cast<uint32_T>(numerator);
        absDenominator = denominator < 0 ? ~static_cast<uint32_T>(denominator) + 1U :
            static_cast<uint32_T>(denominator);
        quotientNeedsNegation = (numerator < 0) != (denominator < 0);
        tempAbsQuotient = absNumerator / absDenominator;
        if (quotientNeedsNegation) {
            absNumerator %= absDenominator;
            if (absNumerator > 0U) {
                tempAbsQuotient++;
            }
        }
        quotient = quotientNeedsNegation ? -static_cast<int32_T>(tempAbsQuotient) :
            static_cast<int32_T>(tempAbsQuotient);
    }
    return quotient;
}

void AutomatedParkingValetModelClass::APV_emxInit_real_T(emxArray_real_T_T
**pEmxArray, int32_T numDimensions)
```



**Modeling &
Simulation**

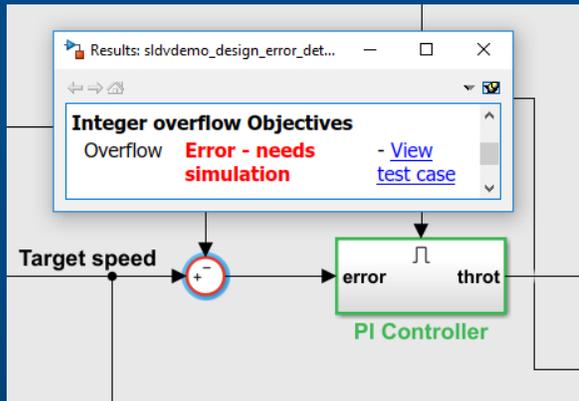
**Test &
Verification**

**Code
Generation**

Automated Test and Verification

TEST & VERIFICATION

Find bugs



Manage tests

Test Manager
TESTS
Filter tests by name or tags, e.g. tags: test
sldtestProjectorFanSpeedTestSuite
Fan Speed Parametric Study
Fan Speed = 800
Fan Speed = 1300
Fan Speed = 1800
Fan Speed = 2300

Fan Speed = 1300
Baseline Test
Select releases for simulation: Select Release
Create Test Case from External File

PROPERTY	VALUE
Name	Fan Speed = 1300
Type	Baseline Test
Model	sldtestProjectorFanSp...
Harness Name	FanSpeedTestHarness
Simulation Mode	[Model Settings]
Location	C:\Program Files\MA...
Enabled	<input checked="" type="checkbox"/>
Hierarchy	sldtestProjectorFanSp...

Check & coverage

slddemo_fuelsys
Created by: The MathWorks, Inc. Revision: 1.742
Collected on: 1/4/2019, 2:45:46 PM 1 Warnings

SIZE
192 Blocks 1 Models 1 Files

MODELING GUIDELINE COMPLIANCE
88.4% High Integrity 74.2% MAAB

ARCHITECTURE
Actual Reuse Potential Reuse 0% 20%

Model Complexity 0 20

Blocks 0 20

Inspect code

Code Verification Results : **Verified**

Function Interface Verification Results : **Verified**

Function	Status	Details
slddemo_roll_initialize	Verified	-
slddemo_roll_step	Verified	-

Model To Code Verification Results : **Verified**

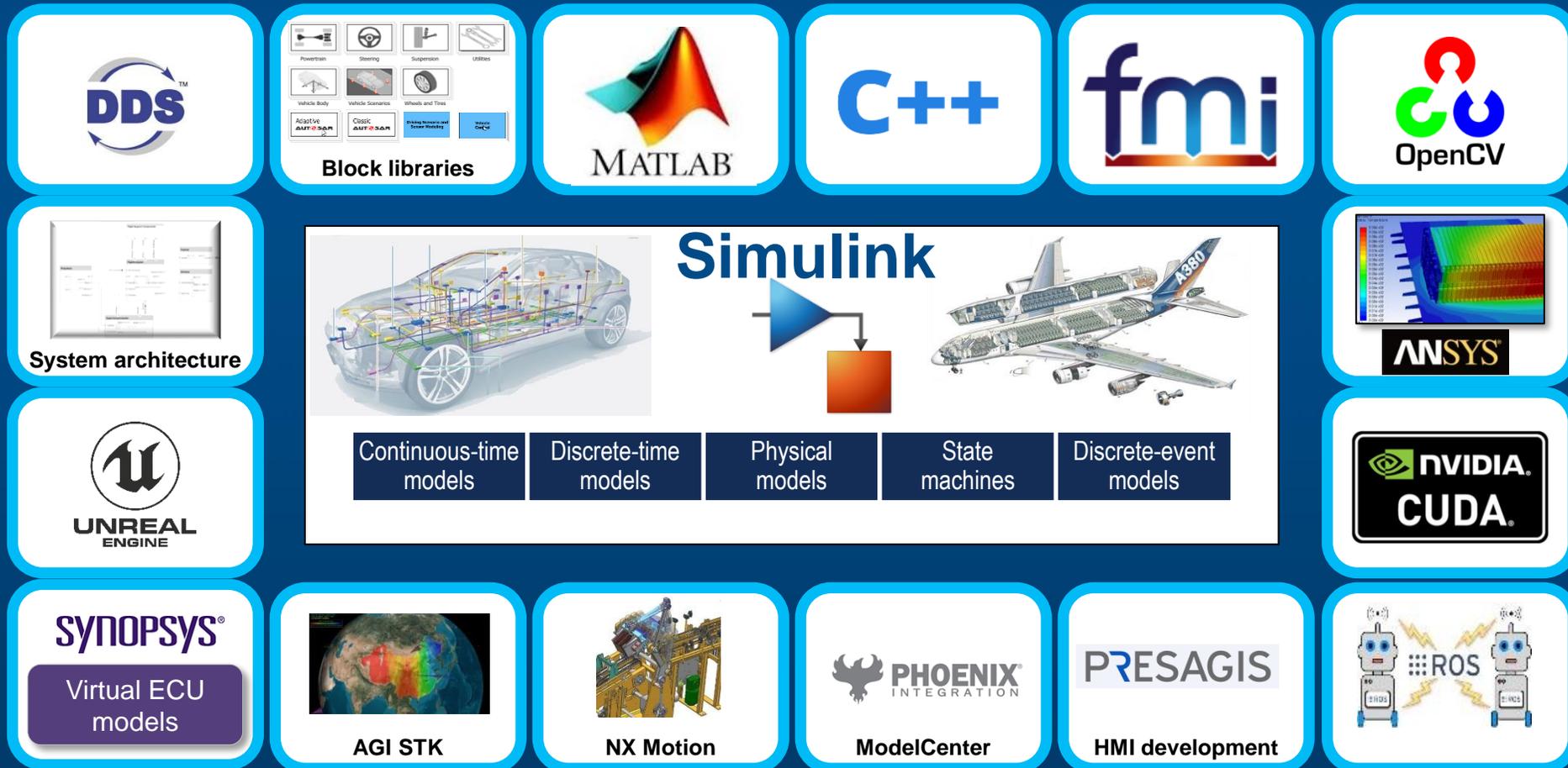
Status	Details
Verified	Model objects with status Verified : 42
	Model objects with status Partially processed : 0
	Model objects with status Unable to process : 0
	Model objects with status Failed to verify : 0

Simulink is the Simulation Integration Platform

Modeling & Simulation

MODELING & SIMULATION

Ecosystem with 100+ third-party tools and languages



Hardware is supported across workflow

CODE GENERATION

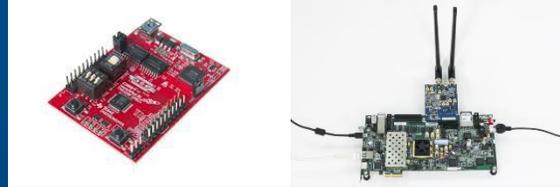
Mass-market low cost hardware

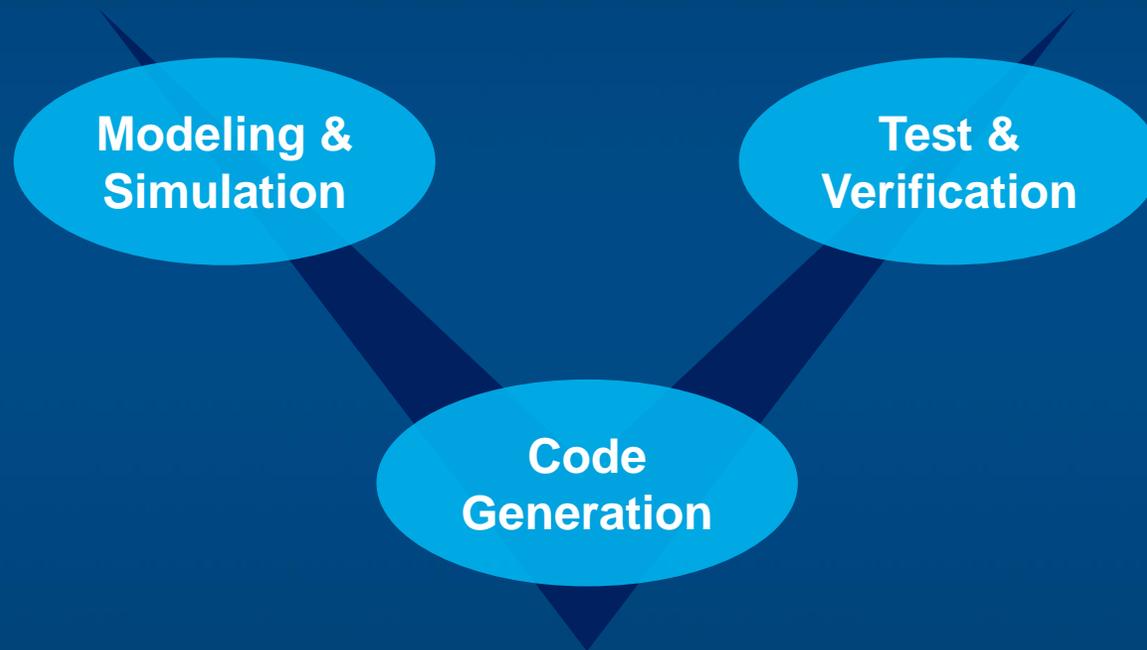


Rapid prototyping hardware

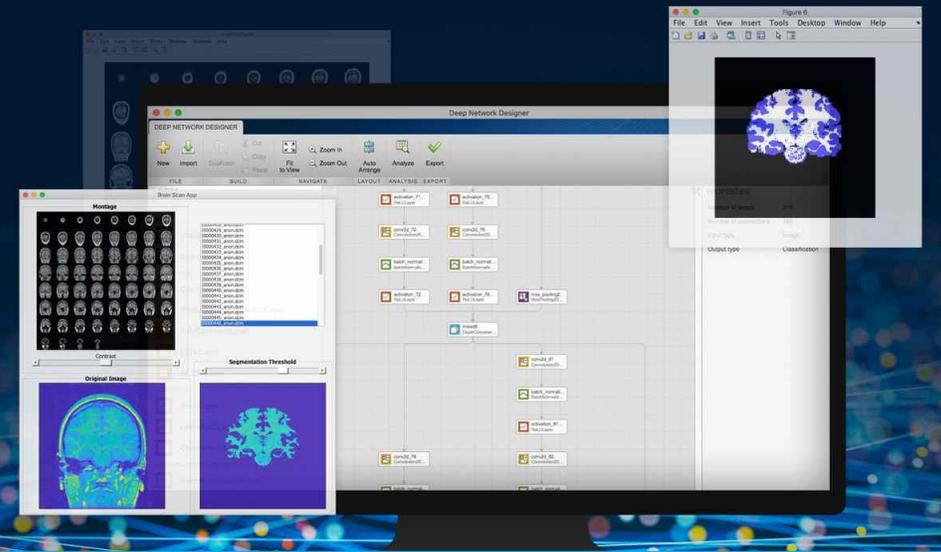


Commercial hardware





MATLAB® & SIMULINK®



The engineering platform for AI





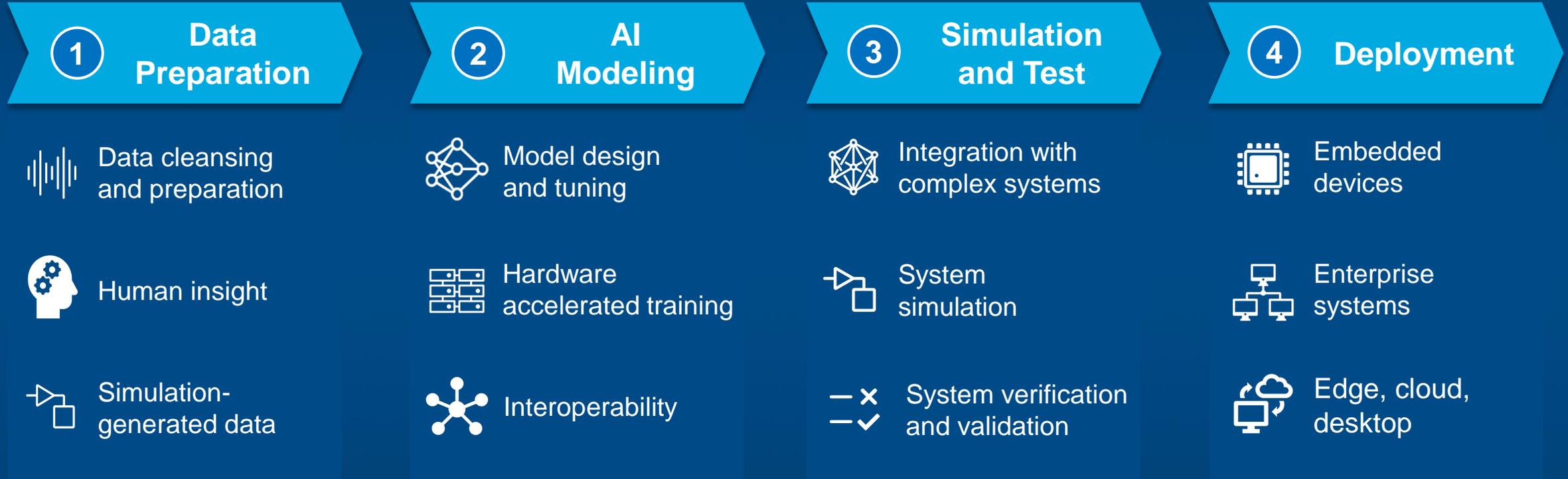
① Data Preparation

② AI Modeling

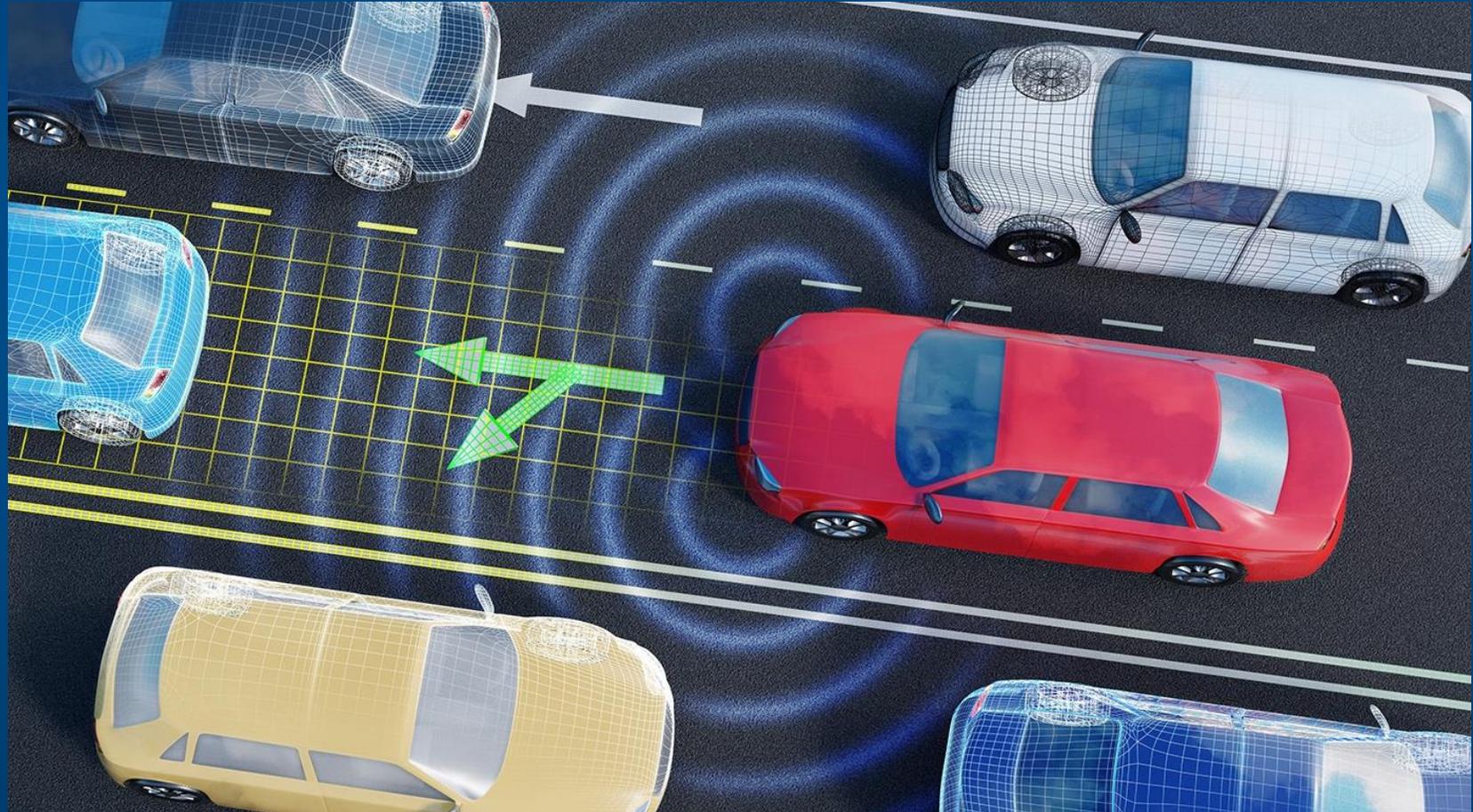
③ Simulation and Test

④ Deployment

AI-driven system design workflow



Integrate AI into system-wide context, simulate before moving to hardware, and verify effectiveness



1 Data Preparation

2 AI Modeling

3 Simulation and Test

4 Deployment

Simulate rare system failures to avoid them in the real world

The image displays a MATLAB/Simulink simulation environment for a pump system. The main window shows a Simulink model with a 'Driver: Motor' block connected to a 'Pump' block. The pump block has six ports labeled Out1, Out2, Out3, In1, In2, and In3. A 3D CAD model of the pump is shown to the right of the Simulink model. Below the Simulink model, a 'Pressure with Noise' plot shows the simulation results over time (0 to 1.5 seconds). The plot shows a noisy signal that starts at approximately 7.05 and rises to about 7.3. A legend indicates 'Sampled with Noise' and 'Simulation'. To the right of the plot, a 'Diagnostics: On' interface shows four circular indicators: 'No Fault' (green), 'Blocked Inlet' (grey), 'Seal Leak' (grey), and 'Worn Bearing' (grey). The 'No Fault' indicator is currently lit green. The simulation is running at T=1.500.

1 Data Preparation

2 AI Modeling

3 Simulation and Test

4 Deployment

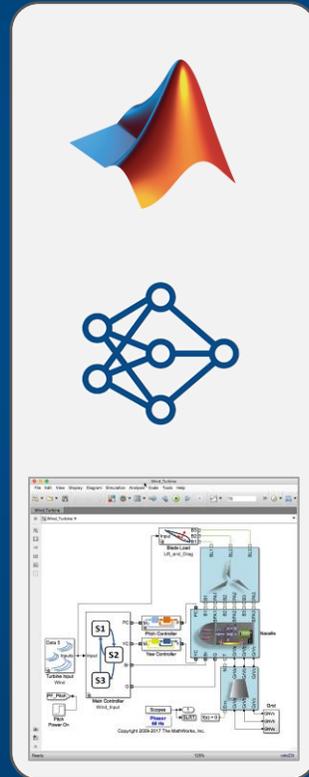
Deploy to any processor with zero coding errors

1 Data Preparation

2 AI Modeling

3 Simulation and Test

4 Deployment

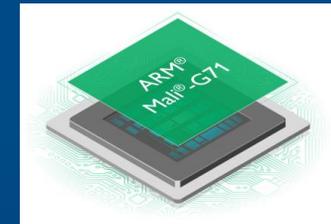


Code Generation

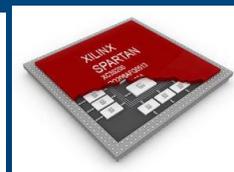
CPU



GPU



FPGA



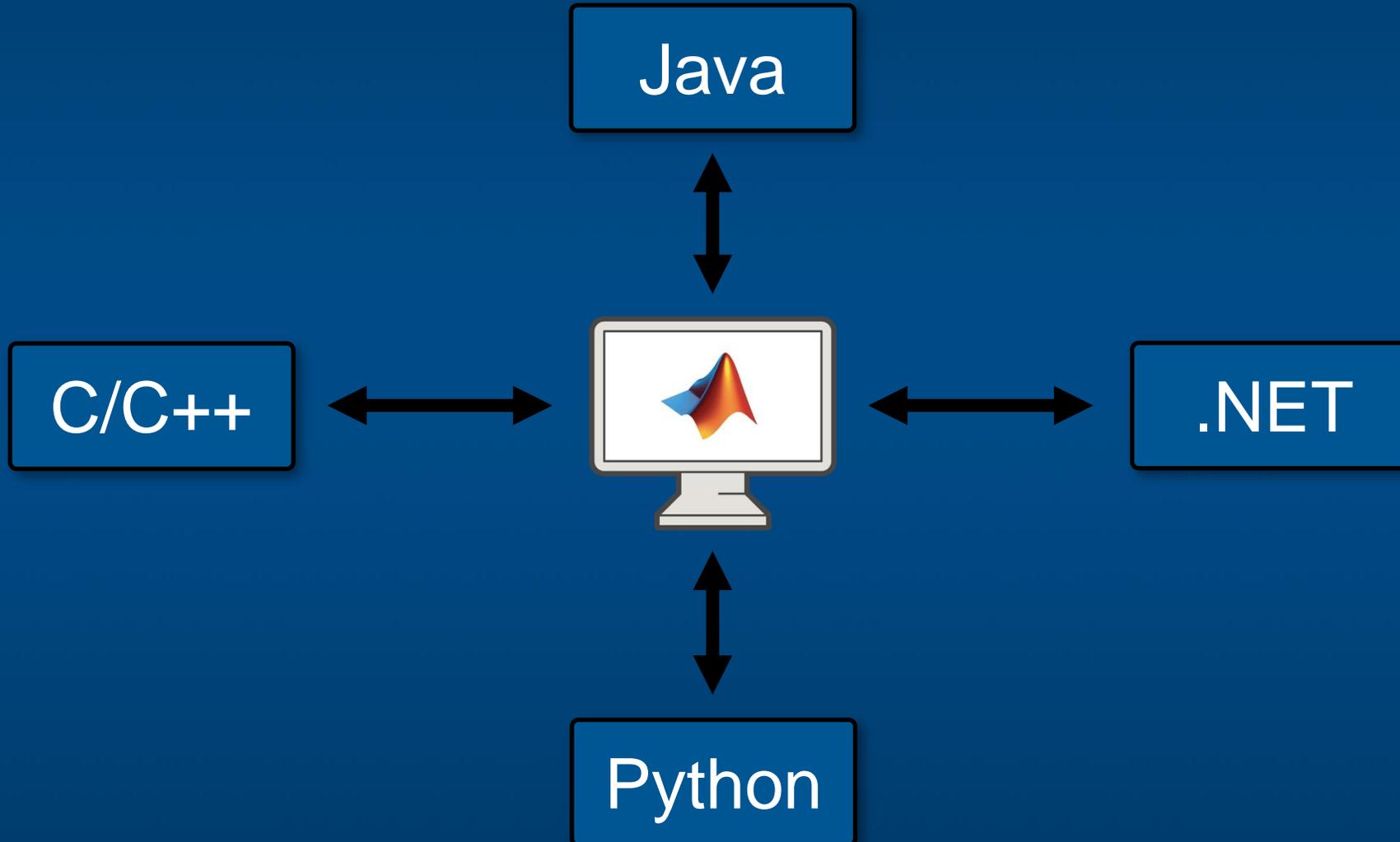
MATLAB provides flexible integration with multiple languages

Data
Access

Co-Execution

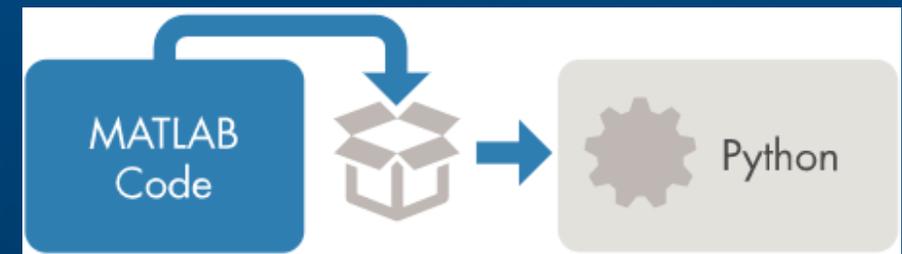
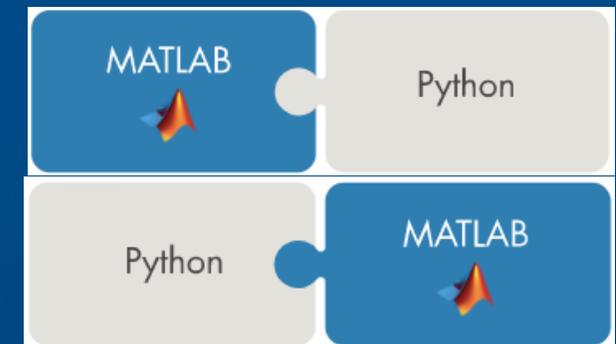
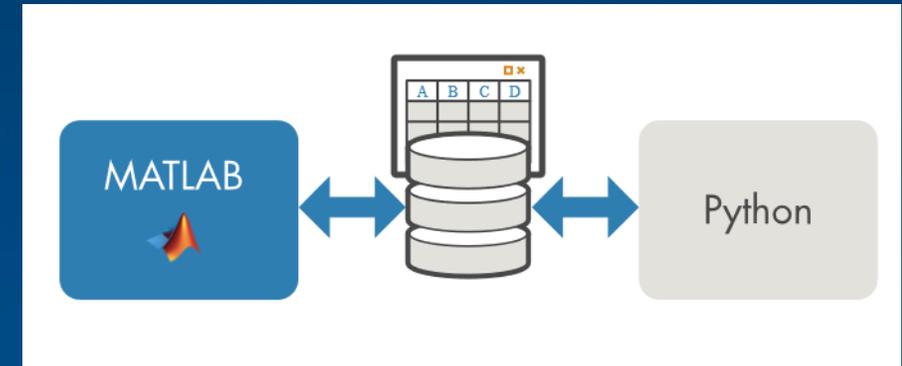
- Call Python from MATLAB
- Call MATLAB from Python

Deployment



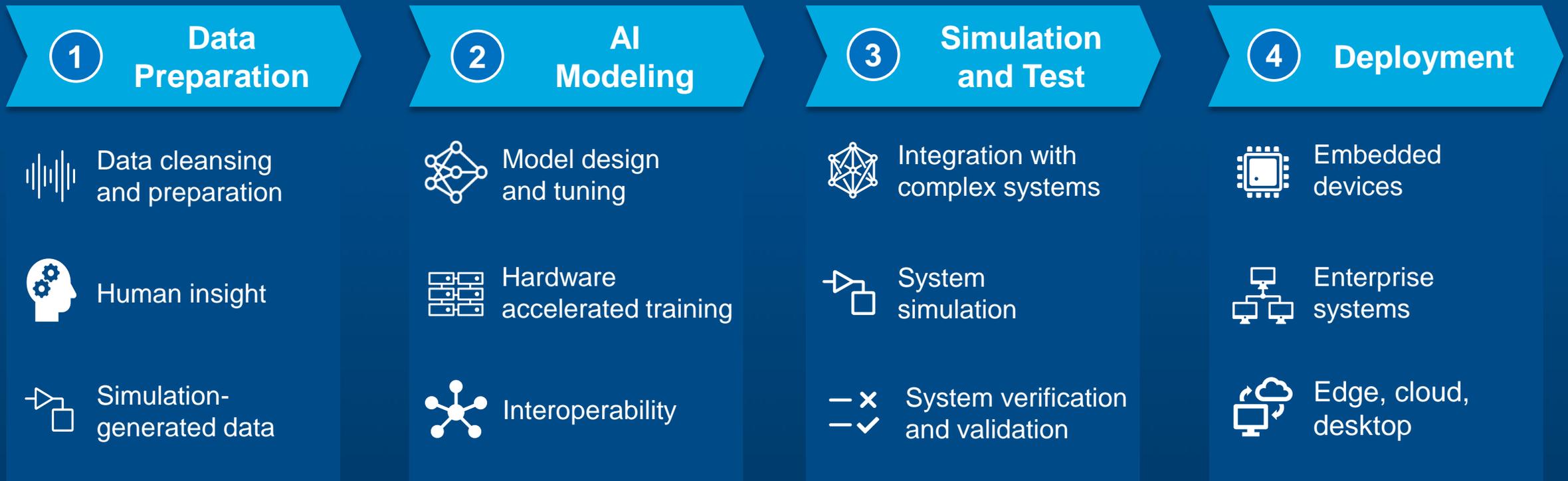
Summary: Using MATLAB with Python

- Access Data
- Interoperability
 - Calling libraries written in Python from MATLAB
 - Calling MATLAB from Python
- Deploy Apps & Algos
 - Web App
 - Production API

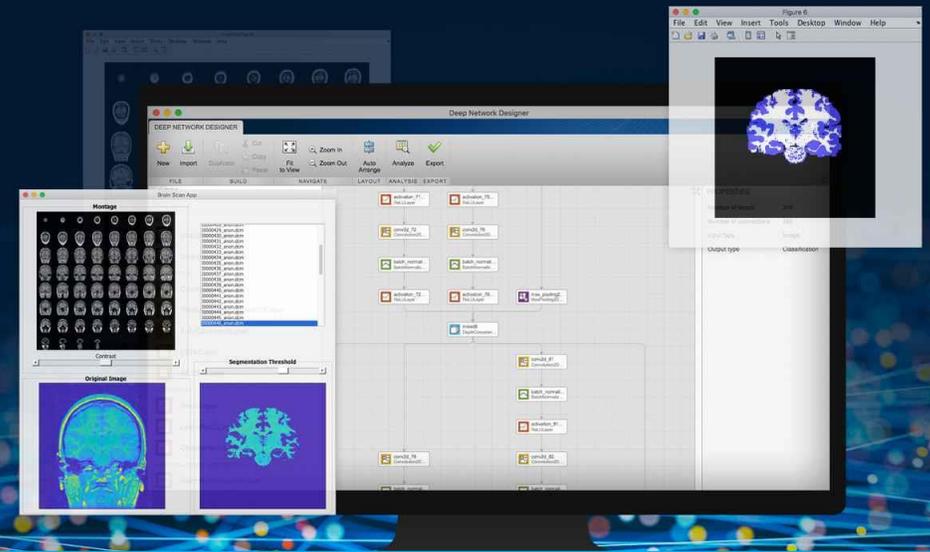


Why MATLAB and Simulink for Artificial Intelligence?

- Empower domain experts, including ones with limited AI experience
- Build better data sets with domain-specific tools
- Use modeling and simulation to tackle integration challenges and reduce risk
- Deploy AI models to wherever you need them



MATLAB® & SIMULINK®

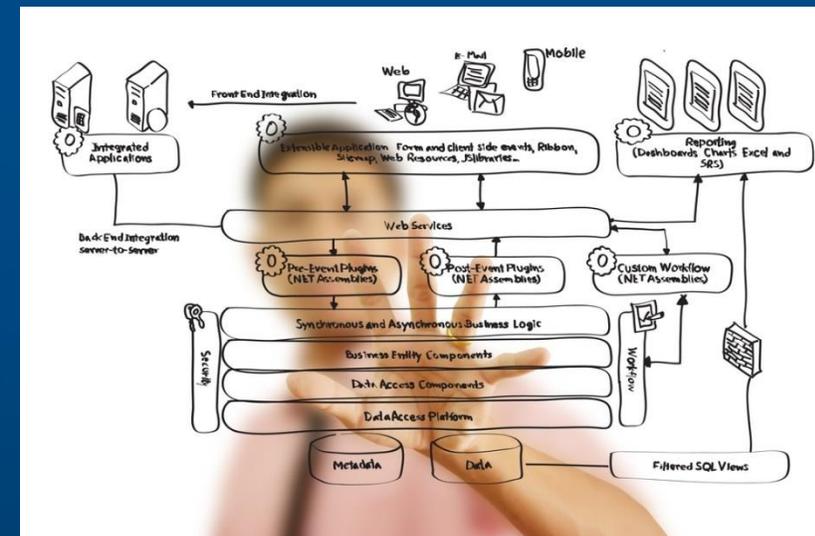


Opportunities



Software Quality Requirements

- Non-functional requirements (System Architecture) impose constraints on functional requirements (System Design)
- Specifying how a system is supposed to be or behave:
 - USABILITY
 - RELIABILITY
 - PORTABILITY
 - COMPATIBILITY
 - REUSABILITY
 - CONFIGURABILITY
 - AVAILABILITY
 - ...



Companies need people who know how to think...

University needs to provide companies with people who know how to think...

Business needs	Impacts
Ability to translate math models of dynamics into systems and behaviors	Core business potentially eroded
Accuracy and fidelity in models	Suboptimal performance, reduced market share
Performance in SW for tests and for deployments	No certifications: barrier to enter new markets
Systemic thinking, ability to optimize	Delays, less innovative, lost sectors
Objectives setting, Track projects, Quality concerns	Impacted communication, quality concerns
Verification & Validation	Compliancy with standards, lost markets
Standards compliancy	Potential barrier
Manage complexity properly and accurately	Lower quality products
...	...

Where should time be invested?

AI & System theory / thinking

- Dynamic models
- Manage complexity
- Requirements management

Data & Test management

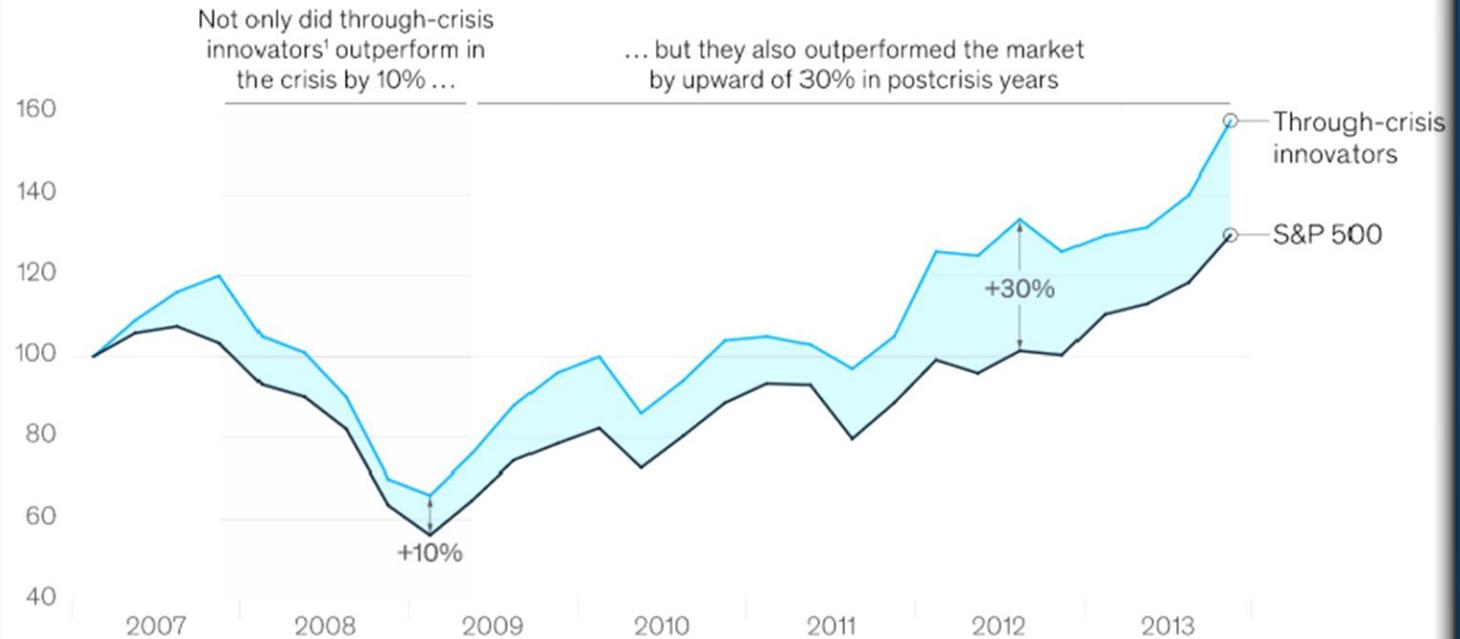
- Optimize Performance
- Verification & Validation
- Quality concerns

Deployment

- Automatic code generation
- Standards & certifications

History suggests that companies that invest in innovation through a crisis outperform peers during the recovery.

Normalized market capitalization, index (Q1 2007 = 100)



*Identified as companies on the *Fast Company* World's 50 Most Innovative Companies list for ≥ 2 years through a crisis, normalized to 2007.

An open exchange for the MATLAB and Simulink user community

A place where you can get answers, challenge yourself and others, and share your knowledge.

Tap into the knowledge and experience of over 100,000 community members and MathWorks employees.

[Ask and Answer](#)[Get & Share Code](#)[Read and Learn](#)[Play](#)[Explore IoT Data](#)

CONTRIBUTORS

365,000

ANSWERS PER DAY

120

DOWNLOADS PER DAY

25,000

SOLVERS PER DAY

730

Project-Based Learning with Low-Cost Hardware

MATLAB and Simulink speak hardware

Treat engineering students like engineers with real projects

Easy-to-learn syntax and block diagrams

Increase student interest and improve learning

<https://www.mathworks.com/hardware-support/home.html>



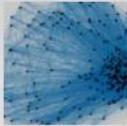
MATLAB for Academia

<https://www.mathworks.com/academia>

Impara le nozioni base

Inizia con lezioni ed esercizi interattivi per acquisire familiarità con MATLAB e Simulink. Tutorial MATLAB e Simulink

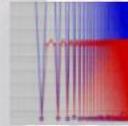
Esercitazioni MATLAB



Esempi di codice MATLAB

Risolvi problemi come il curve fitting, il plottaggio e l'elaborazione di immagini con esempi di codice.

» Per saperne di più

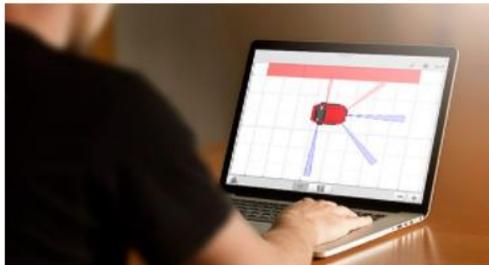


Esempi Simulink

Scopri la modellazione e la simulazione di diversi sistemi dinamici guidato da script e file di modello.

» Per saperne di più

Insegna e ispira



Insegnare con MATLAB e Simulink

Migliora il tuo corso di studi con strumenti didattici ed interattivi pronti all'uso

» Visualizza tutti i materiali didattici



Fare ricerca con MATLAB e Simulink

Esplora ed esprimi nuove idee, collabora con GitHub e crea codici e modelli robusti e riutilizzabili.



Crea e valuta automaticamente le attività

Utilizza MATLAB Grader per creare attività di programmazione MATLAB per gli studenti e valuta automaticamente il loro lavoro.



Corsi MATLAB

Scarica i contenuti dei corsi per sviluppare e migliorare il tuo curriculum.



Live Editor

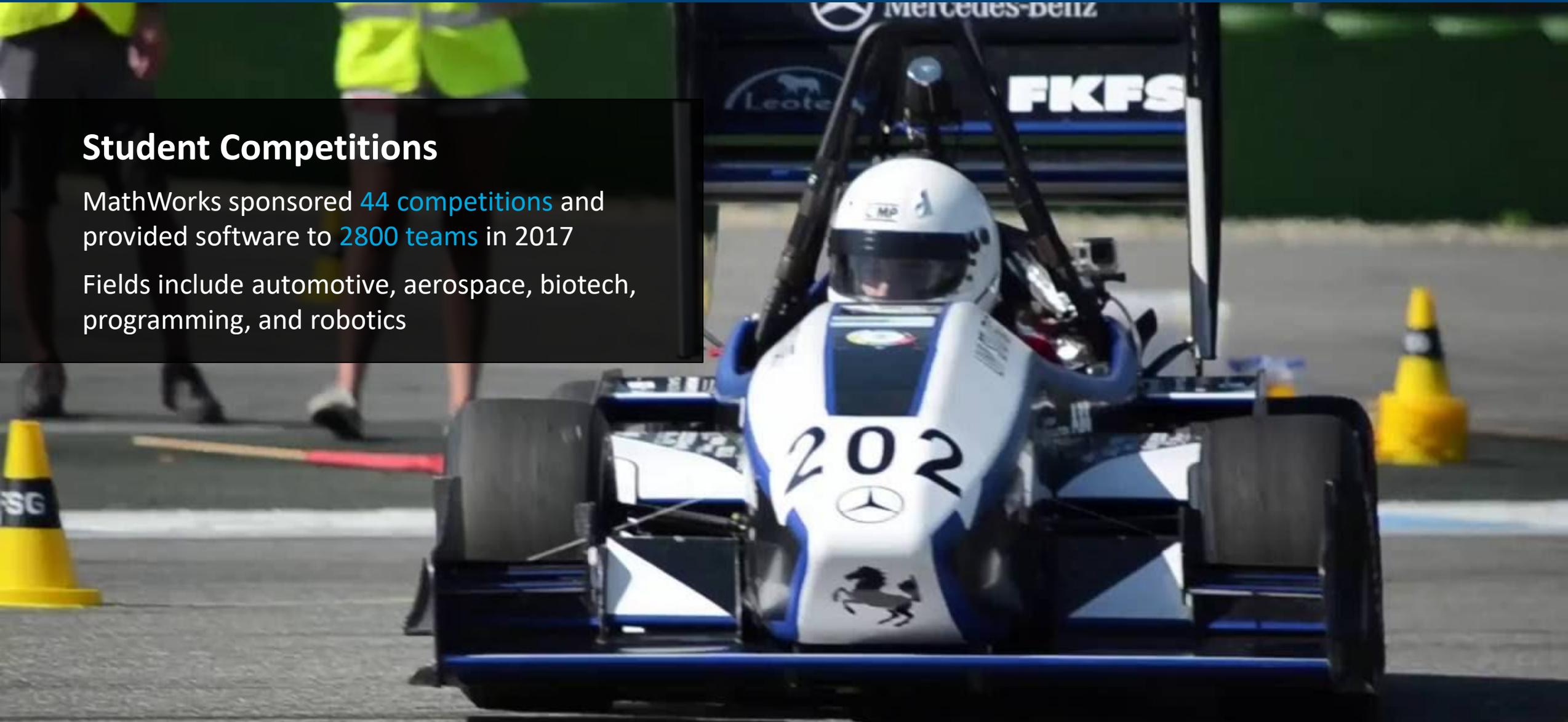
Crea lezioni che combinino testo esplicativo, equazioni matematiche, codici e risultati.

Student Competitions prepare students for careers

Student Competitions

MathWorks sponsored [44 competitions](#) and provided software to [2800 teams](#) in 2017

Fields include automotive, aerospace, biotech, programming, and robotics



Self-Paced, Online Training for MATLAB & Simulink

Deep Learning Onramp (0% complete)

2.1 Course Example - Identify Objects in Some Images

Task 2

You can use the `imshow` function to display an image stored in a MATLAB variable

```
imshow(I)
```

TASK
Display the imported image in the variable `img1`.

Submit Next task

Test Results: **Correct!**
✓ Is `img1` displayed correctly?

View image files

Instructions are in the task pane to the left. Complete and submit each task one at a time.

Task 1
Import an image

```
1 img1 = imread('file01.jpg')
```

Task 2
View image

```
4 imshow(img1)
```

Task 3
Import and view more images

```
img1 = 227x227x3 uint8 array  
img1(:,:,1) =  
90 90 89 87 85 84 83  
91 91 90 88 87 85 84  
93 92 91 90 89 88 87  
95 94 94 93 92 91 91  
97 97 96 96 95 95 95  
99 99 99 99 98 98 98  
100 100 101 101 101 101 101  
101 101 102 102 102 102 102  
103 102 115 105 106 113 108  
112 100 105 108 109 110 112  
120 132 120 120 112 102 96  
128 90 118 119 117 109 51  
119 100 128 117 124 120 75  
134 145 67 77 82 62 71  
101 00 10 41 65 60 57
```

Campus-Wide Online Training

Hands-on MATLAB and Simulink experience

Measurable progress report and completion certificate

Interactive lessons with immediate feedback

24/7 availability

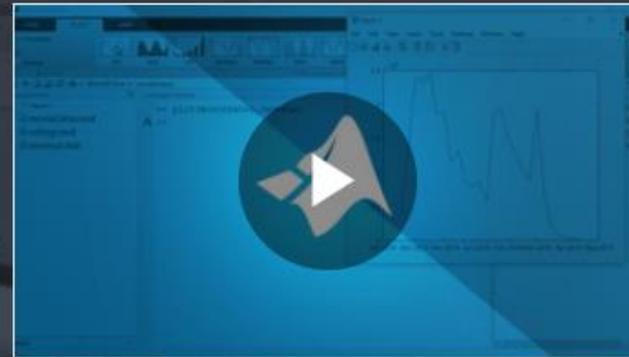
MATLAB Onramp

<https://www.mathworks.com/learn/tutorials/matlab-onramp.html>

MATLAB Onramp

Learn the essentials of MATLAB® through this free, two-hour introductory tutorial on commonly used features and workflows.

Launch the course



Access to MATLAB through your web browser



Engaging video tutorials



Hands-on exercises with automated assessments and feedback



Lessons available in English, Chinese, Spanish, Japanese, and Korean

Companies Compete for better Productivity

Quality is Productivity

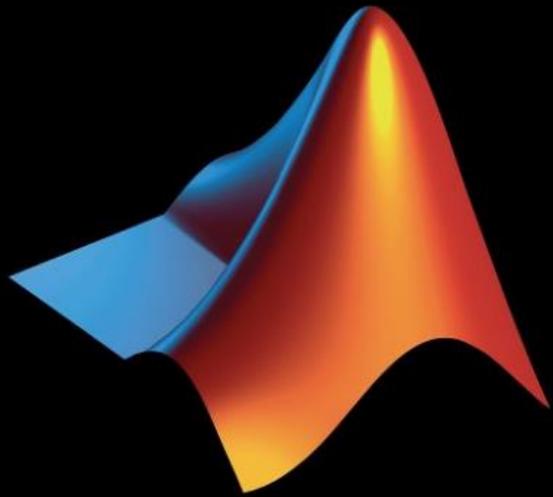
Quality is driven by Competence

Summary

- Companies and Business require you to...
 - Develop and invest in algorithm & systems modeling and simulation skills
 - Learn to work in Teams

- MATLAB is in these markets already, since 1984
- MATLAB is the backbone of many engineering applications
- The MathWorks is making the right investments





MathWorks®

Accelerating the pace of engineering and science